Volume 29 September, 1943 *Number 9*

Lubrication

A Technical Publication Devoted to the Selection and Use of Lubricants

THIS ISSUE

The Electric Industrial Truck and Tractor

PUBLISHED BY
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LUBRICATION

A TECHNICAL PUBLICATION DEVOTED TO THE SELECTION AND USE OF LUBRICANTS

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The Electric Industrial Truck and Tractor

In Production: The link between the production line and the shipping department; the means of expediting a variety of loading and packing operations; the adjunct to low-handling costs in storage.

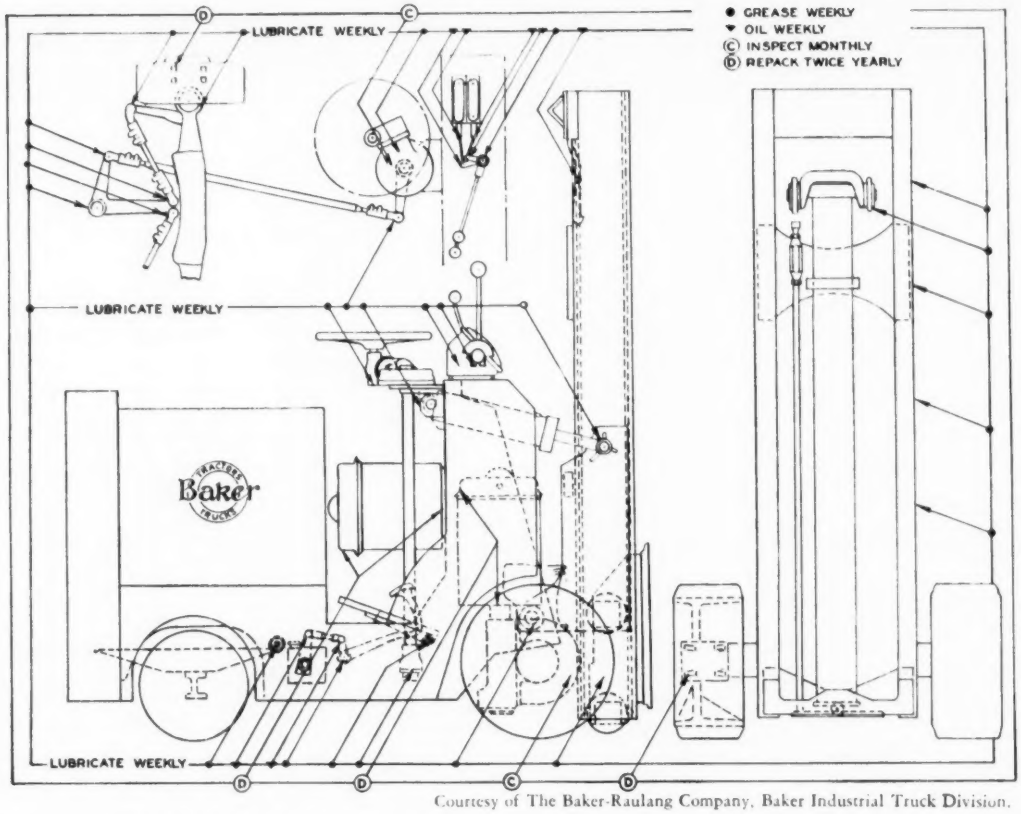
At War: The means of reducing man-power at depots where unloading and distribution must be accomplished with minimum loss of time.

These are the functions of the modern electric industrial truck. It is quite obvious that delay at any stage of manufacture or in the handling of finished materials can slow down the production of an entire plant or retard shipping to the extent that freight movement, train make-up or even convoy sailings might be affected.

KEEPING things moving is the keynote in War Production. The job of keeping things moving is a job of materials handling. American Industry developed the ways and means when it adapted the electric industrial truck to the production line. It was fully realized that, regardless of the efficiency of operation of any particular machine, unit or department, efficient production of the plant as a whole will depend upon coordination of process work by the handling of materials to and from each stage of treatment with the greatest expediency. The electric truck became the "jeep" in industry; versatile, quick moving, easily maneuvered and economical. Today it is fully living up to the reputation it gained when several thousand refrigerators, automobiles or vacuum cleaners a day was the major objective.

The remarkable fact is that all this hinges upon a feature of machine maintenance which can become a forgotten detail — Lubrication. In other words, keeping things moving involves friction and power consumption. Lubrication is the only solution to the reduction of friction.

When this is accomplished, wear is reduced and the effect is reflected upon the cost of maintenance and the fuel bill. Then production is developed with minimum expense and maximum output. Expense includes not only the cost of raw materials but also the cost of operating the machinery involved. It can become quite a fluctuating item, according to the cost of maintenance.



Courtesy of The Baker-Raulang Company, Baker Industrial Truck Division.

Fig. 1—Lubrication chart covering the Baker type JOMH center-control fork truck. Hydraulic lifting, anti-friction bearings and housed lubrication are features which promote durability and dependability.

FIELD OF SERVICE

The electrical industrial truck or tractor is well adapted to the expediting of work within the plant, that is, from one set of machinery to another, for the transportation or lifting of heavy, bulky products. The term truck is generally applied to such a vehicle as carries its own load directly; tractor, in turn meaning a self-propelled vehicle which is used for pushing or pulling other conveyances which carry the load. As a rule a tractor will not be designed to carry any load itself. The word truck, may mean either an electric (storage battery) driven machine or a motor truck.

The electric truck, tractor or crane is an especially desirable vehicle for handling materials within buildings or over distances below about one half a mile as a maximum. Over longer distances the gas tractor or motor truck will probably function more economically than the storage battery truck. This matter of choice of vehicle for any type of hauling must be worked out on a unit cost basis per ton of materials hauled over the distances involved.

The necessity for periodic charging of storage batteries is the criterion in regard to distance hauling, for the electric industrial truck can function effectively only provided that its battery is properly charged.

Lubrication of the electric or storage battery vehicle must be studied from three view-points, i.e., as involving drive gears, elevating gears (where installed) and the so-called chassis parts. The latter will include the wheel bearings, universals and steering gear parts, the brake connections and the controller elements.

MOTIVE POWER

The high starting loads which normally prevail in electric truck operation require maximum tractive effort and acceleration at low speeds. Motors of high starting torque are best suited to this type of service. Quite obviously the motor must be able to come up to speed and carry its load without delay. This can be best assured by eliminating conditions which might interfere with free turning of the armature. Abnormal wear due to faulty lubrication of motor bearings and armature journals can seriously reduce the motor speed, and by causing a false overload, can reduce the power output capacity. At the same time the bearing temperatures will probably be unnecessarily increased. Unless corrected an overhaul job may be required, with perhaps renewal of the bearings and rewinding of the motor.

Motor Design

The electric motor consists essentially of a frame or stationary element known as a stator, and a revolving armature or rotor. The former contains a number of field poles suitably wound with wire; the latter is fitted with a series of coils of wire. Delivery of electric current to one or both windings brings about rotation of the armature in accordance with the law that a magnetic pole will attract or repel an electric conductor, such as an armature coil, in which an electric current is flowing, according to the polarity.

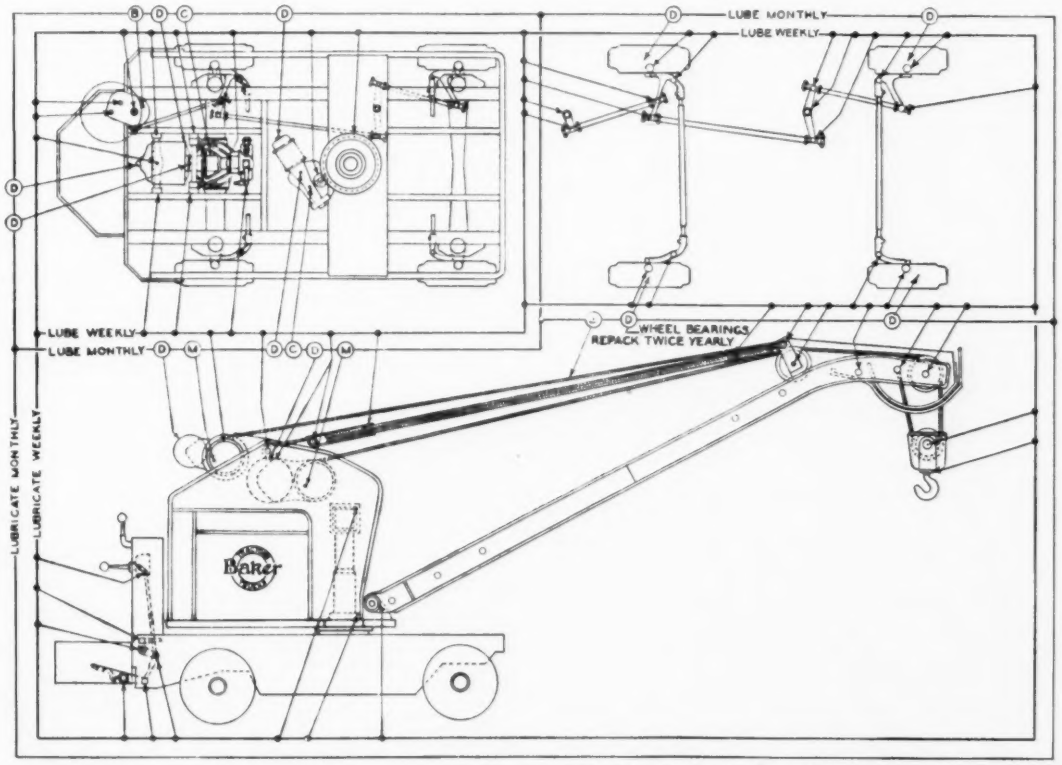
The rotor involves a central shaft or journal, which in turn must be carried in suitable bearings located in the stator or frame. These are the only wearing parts of the electric motor wherein lubrication is necessary.

The Importance of Lubrication

Anti-friction bearings will, in general, be involved according to the type of truck, the intended duty and the design of the builders. The fact that these are the principal wearing elements too frequently promotes the opinion that they require less than the average amount of attention.

Many operators, especially those who are comparatively new on materials handling work, may be apt to overlook the importance of lubrication; what this lubricant should be; the constructional details of the bearings; and the lubricating requirements imposed by the operating conditions. This is pardonable to some extent, for the builders of electric motors have given every care to the design of their bearings in order to render lubrication as positive and automatic as possible. So the average truck motor under normal conditions of operation should experience little or no difficulty from a lubricating point of view.

But war production conditions are not normal. Continuous service is required, trucks must be run exposed to the elements, and overloading is customary. Such conditions require an intimate knowledge of the construction of the motor bearings, the methods of sealing to prevent loss of lubricant, and the durability of any prospective lubricant.



Courtesy of The Baker-Raulang Company, Baker Industrial Truck Division.

Fig. 2—Lubrication chart for the Baker type CFX crane truck. For the parts indicated the builder suggests:

A—At weekly intervals in oil holes use an SAE #10 motor oil. In grease fittings use a high quality pressure gun grease or one made with a lime soap base and a good grade of mineral oil of around 300 second Saybolt Universal at 100° F.

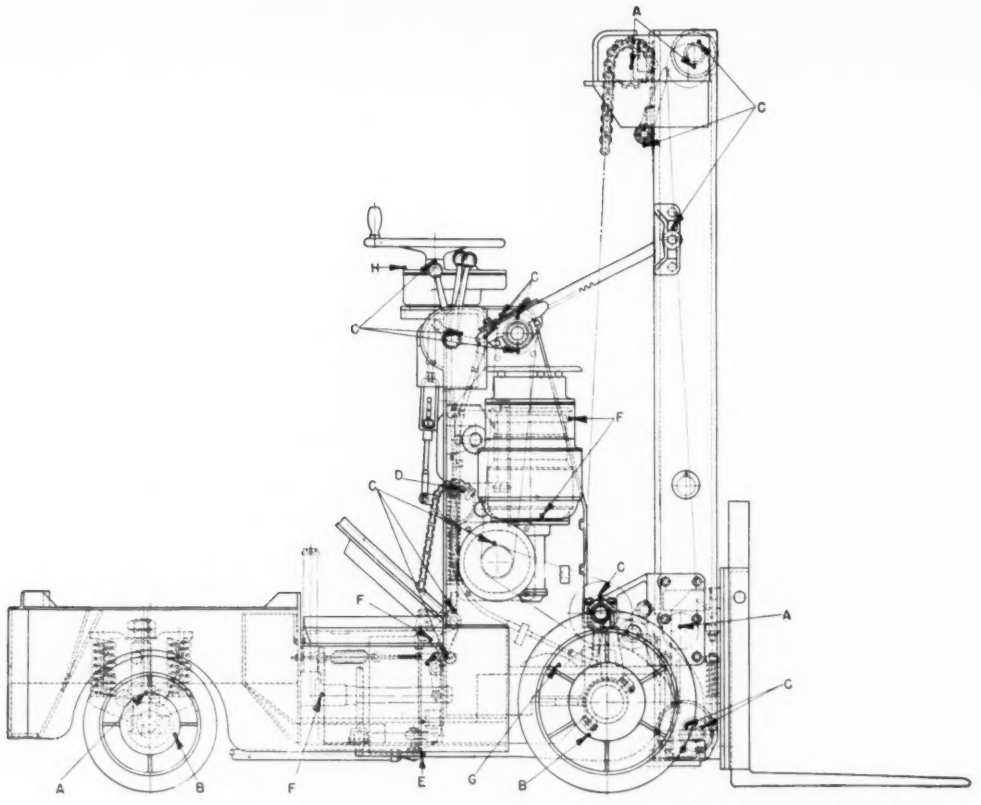
B—Change transmission lubricant twice yearly. Check the level monthly. Use a gear lubricant acceptable to the manufacturer.

C—Check oil level monthly. Change twice yearly. Use an SAE 90 hypoid gear lubricant acceptable to the manufacturer.

D—On ball and roller bearings use a high quality ball and roller bearing grease. Lubricate monthly unless otherwise indicated and use sparingly.

E—Motor oil SAE 20 should be brushed on cables weekly.

M—On parts which call for a heavy oil use No. 70 SAE motor oil. Check level monthly and change twice yearly.



Courtesy of The Elwell-Parker Electric Company.

Fig. 3—Lubrication guide for a typical Elwell-Parker truck.

A—Ball and roller bearings should be greased monthly with a high quality ball and roller bearing grease.

B—Drive wheel bearings should be serviced with a similar grease.

C—Plain bearings should be oiled daily, or greased by pressure gun (if fittings are provided).

D—The worm gear should be lubricated with a product acceptable to the manufacturer. Check the level weekly; drain and refill every three months.

E—Steering ball joints require monthly servicing with a high quality grease as indicated for ball and roller bearings. The same holds true for motor bearings, "F". Check these latter every two weeks and grease sparingly.

G—Keep spur gear housing filled to level of overflow plug with a lubricant acceptable to the manufacturer.

H—Inspect the steering gear monthly. Grease when necessary with a high quality pressure-resisting grease.

SELECTION OF BALL AND ROLLER BEARING LUBRICANTS

When a ball or roller bearing housing is sufficiently oil-tight the motor builders may provide for oil lubrication with the thought that highly refined straight mineral oils of suitable body are most resistant to breakdown under the severe conditions of temperature fluctuation which so often prevail.

The viscosity of oil to use depends upon the operating temperature. Normally an oil within the S.A.E. 10 to 20 range is preferred; the lighter the oil the less heat will develop through internal friction. This is an important factor if a truck is working in a hot depot building or warehouse, or around heat-treating or process machinery in production. The oil level should also be watched, for churning of an excess of oil by the bearing elements causes heat, and also may cause seals to leak due to internal pressure.

Oils of heavier body, however, may be desirable if the motor is equipped with roller bearings which may be subject to end thrust. Under such conditions an oil within the S.A.E. 30 or 40 range may be advisable, especially if at the same time the operating temperatures are consistently above 100°F.

When Grease Is Desirable

Ball or roller bearings are designed for grease lubrication if an oil-tight seal is impracticable. In such bearings grease resists leakage better than oil, also it prevents entry of dust, dirt or moisture more

effectually. On the other hand, dirt or grit which finds its way into a grease lubricated bearing does not settle out readily and as it is carried in suspension by the grease, it is more apt to cause bearing wear or scoring. Grease has a further advantage in that it does not settle readily to the bottom of the housing when the motor is idle. This reduces the possibility of rusting or corrosion in damp or acidic atmospheres, as there is but little possibility of the bearing elements becoming cleared of lubricant.

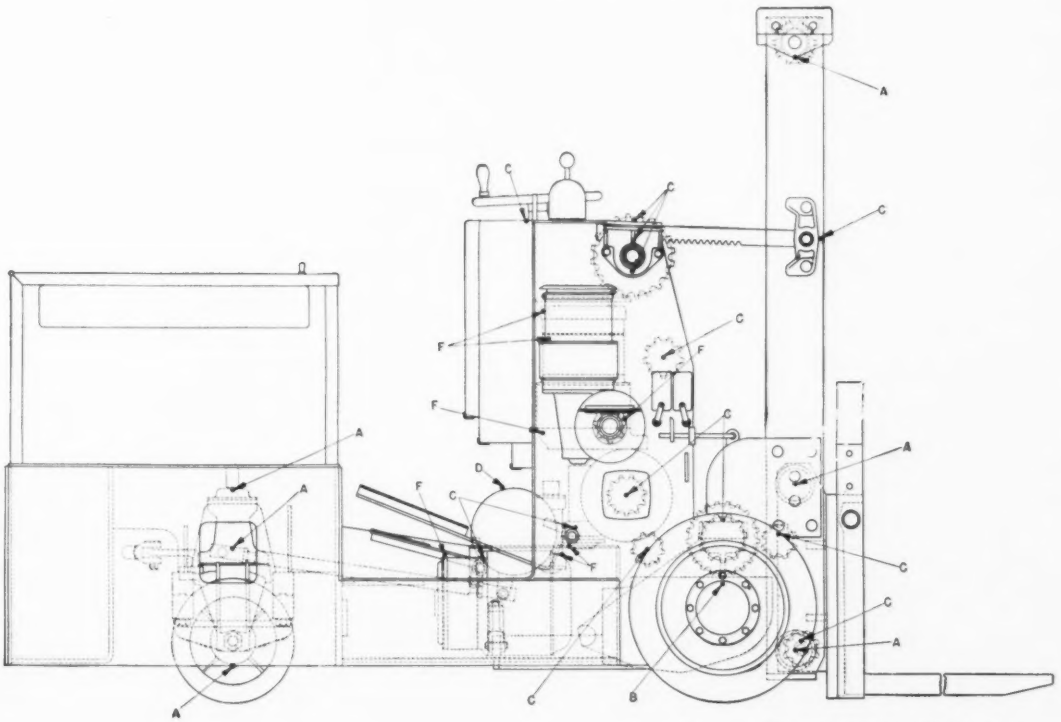
Greases which conform to the N.L.G.I. number 2 consistency classification are normally best suited to electric truck motor ball or roller bearings. Such greases will cover the entire surfaces of the rolling elements, won't channel to excess, and if properly made they will resist oxidation and aeration for long periods of time.

Relubrication should be carried out with care. A ball or roller bearing must not be over-charged with grease, otherwise expansion of the latter might cause breakage at the seals. Relubrication every four or eight weeks should suffice if the seals are in good condition and the grease is a quality product and resistant to oxidation. Every six to eight months it is well to flush clean and repack truck motor bearings with a fresh charge of grease. This may be advisable more frequently if the operating conditions are severe, if the truck operates under high temperatures, or if it is exposed to the weather or acids in the air.

Motor Protection

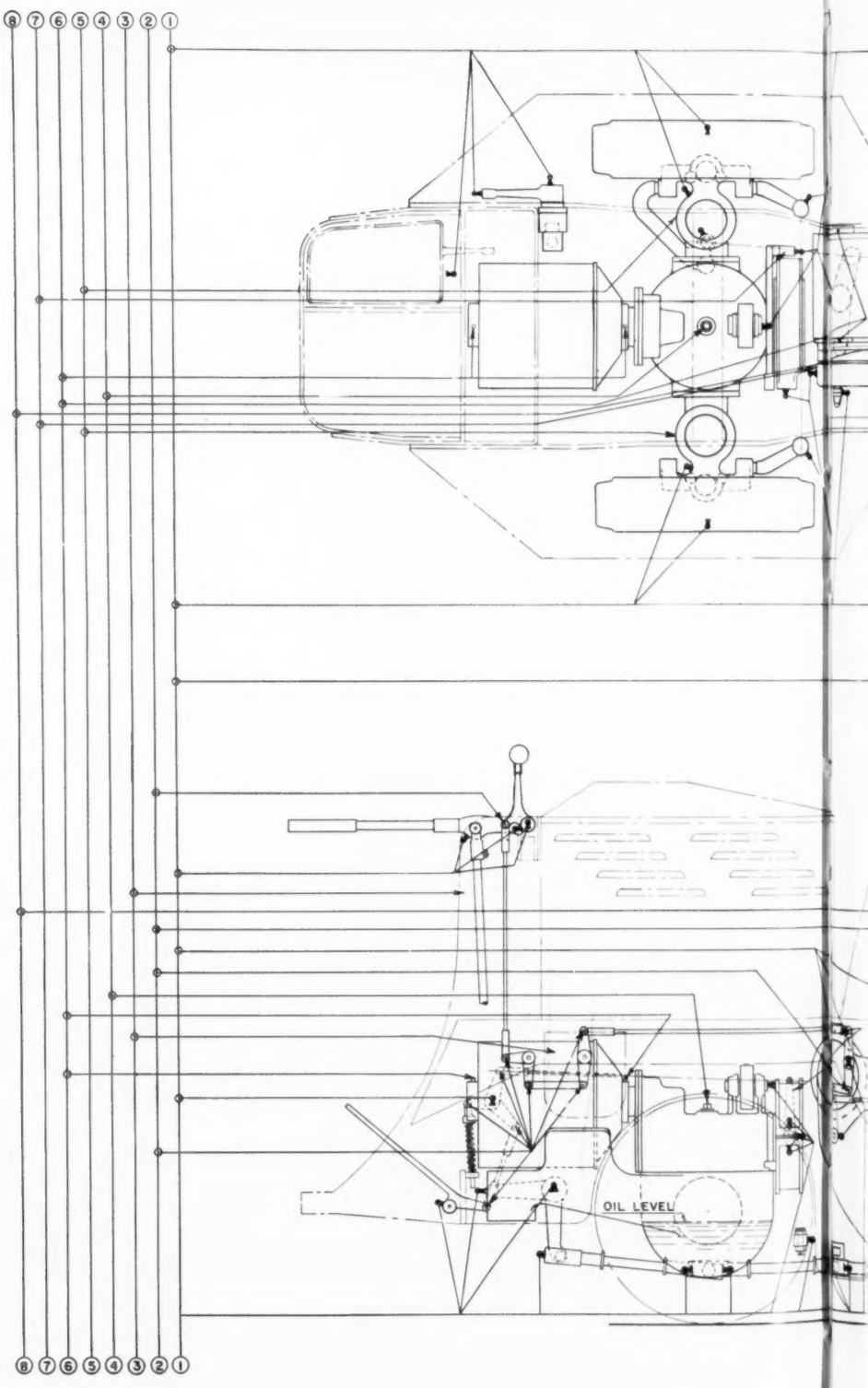
The windings of an electric motor must be as carefully protected as the bearings. The motor of the electric industrial truck requires particular attention due to the possibility of windage causing considerable accumulation of abrasive foreign matter when the trucks are operated in dusty surroundings. Windage through an oil-lubricated bearing also can be the cause of oil accumulations on the windings, due to oil spray when the oil level is carried too high or the bearing is not oil tight.

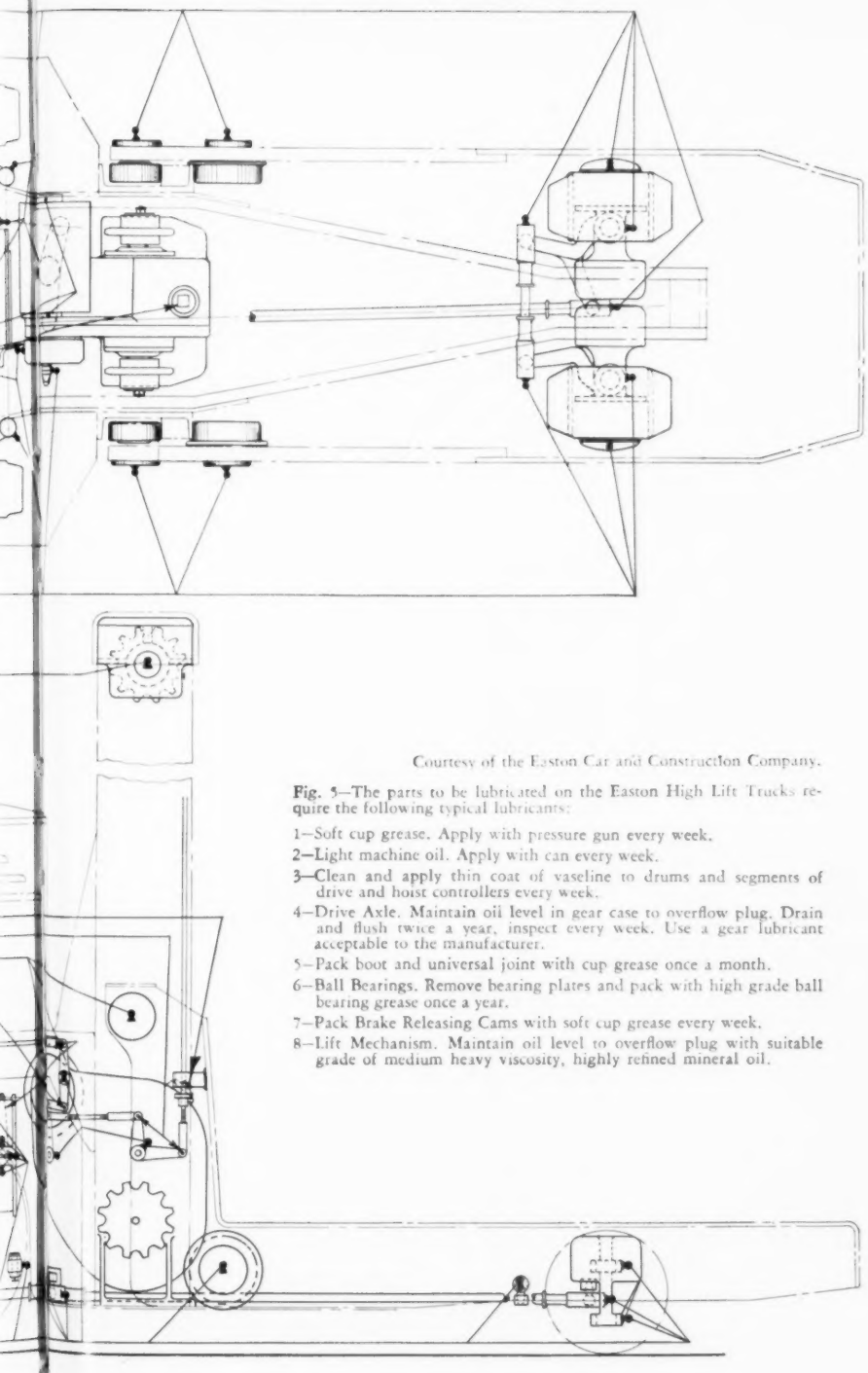
Oil baffles, throwers or labyrinth packing on the motor or inboard side of each bearing can be installed to prevent loss of oil by windage. In effect, these devices prevent direct circulation of air from the outside and through the bearing. At the same time they prevent the dust content of this air from exerting an abrasive action on the motor shaft or bearing surfaces.



Courtesy of The Elwell-Parker Electric Company.

Fig. 4—Another typical Elwell-Parker lift truck. The same conditions of lubrication prevail as noted for Fig. 3. On this truck the builder advocates for the worm and spur gears a straight mineral gear oil or turbine grade lubricant of SAE 140 range for summer service, and an SAE 80 range for winter.


8 7 6 5 4 3 2 1
OIL LEVEL
8 7 6 5 4 3 2 1



Courtesy of the Easton Car and Construction Company.

Fig. 5—The parts to be lubricated on the Easton High Lift Trucks require the following typical lubricants:

1—Soft cup grease. Apply with pressure gun every week.

2—Light machine oil. Apply with can every week.

3—Clean and apply thin coat of vaseline to drums and segments of drive and hoist controllers every week.

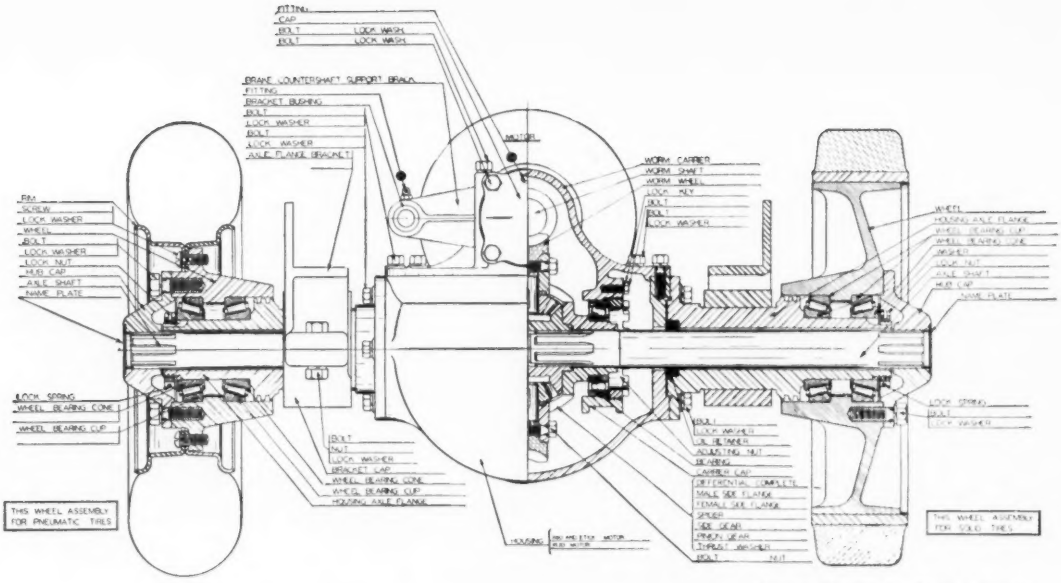
4—Drive Axle. Maintain oil level in gear case to overflow plug. Drain and flush twice a year, inspect every week. Use a gear lubricant acceptable to the manufacturer.

5—Pack boot and universal joint with cup grease once a month.

6—Ball Bearings. Remove bearing plates and pack with high grade ball bearing grease once a year.

7—Pack Brake Releasing Cams with soft cup grease every week.

8—Lift Mechanism. Maintain oil level to overflow plug with suitable grade of medium heavy viscosity, highly refined mineral oil.



Courtesy of Crescent Truck Company.

Fig. 6—Driving axle assembly for a Crescent Type "L" driving unit. Note parts identity. Parts marked ● are pressure grease fittings for mechanisms which should be lubricated at least once a week.

THE FINAL DRIVE

Final drive gearing in the electric industrial truck involves only the differentials at the rear axle. There are no transmission gears as such since the necessary speed changes are made through electric control.

Accordingly the geared axle of the electric truck is generally known as the power or drive axle. In many machines it is located so adjacent to the electric driving motor that a common housing will be practicable, enclosing both gearing and motor connections. (See Fig. 6.) In this way the same lubricant can be used for both gears and bearings.

Either spur or worm gears are used according to the type of truck, and the duty required.

Influence of Construction

Gear and motor housings of an oil-tight nature are built to enable the lubricant to function effectually and to prevent undue contamination from dirt, water, or other foreign matter.

Considerable attention has been given to this matter of protection of lubricants and mechanical equipment. In consequence, the selection can as a rule be safely made from the viewpoint of bearing requirements and gear tooth pressures involved, provided proper attention is given to periodic renewal and draining of the gear housing to avoid contamination.

Selecting the Lubricants

An automotive type of gear lubricant within the SAE 90 or 140 range is normally best adapted to the final drive mechanisms in the average electric truck; adequate fluidity is necessary wherever bearings must be served by the same lubricant.

Were gearing alone to be involved it might be practicable, and to good advantage oftentimes, to use a somewhat more viscous gear lubricant. The increased degree of adhesiveness obtainable would perhaps insure more positive protection of the gear teeth, with frequently greater economy.

Renewal of Lubricant

Provided that the gear housing can be kept sufficiently oil-tight to prevent excessive leakage of lubricant, this latter should be renewed only about once a month in normal service. On the other hand, frequency of renewal will depend upon the intensity or hours of operation.

It is well to remember that it is not so much a matter of deterioration of lubricant as it is loss through leakage, or contamination by dust, dirt or metallic particles, which requires consideration.

Draining and Flushing

Approximately twice a year it will also be advisable to drain and flush the housing to completely remove all used lubricant. This will hold true regardless of the type of lubricant which is employed. The possibility of contamination with foreign matter will prevail in almost any type of service.

When draining of a power axle housing is to be carried out, it should be flushed with kerosene or a light motor oil or flushing oil, after the greater part of the used lubricant has been drawn off. Flushing

in this manner will insure the removal of gummed lubricant, dirt, metallic particles or any other non-lubricating matter that may have accumulated.

Filling the Gear Housing

To avoid the possibility of leakage, or the chance of excessive power consumption by the drive, it will be well to use care and judgment in re-filling the power axle gear housing after draining. The same applies when it is necessary to add lubricant at the time of any regular monthly inspection.

As a general rule it will be the recommendation of truck builders to carry such a lubricant at the level of the filling plug or opening. Where a comparatively viscous straight mineral lubricant is used and the truck is to be operated under low temperature conditions, a noticeable decrease in pulling power will often be evident should such a lubricant be carried too high. In such cases it may be advisable to carry the lubricant level slightly below the filling plug level, especially where initial starting in a cold building, etc., may be necessary.

Conversely, it is important to note that leakage may occur in certain equipment under higher temperature service if the oil level is carried too high, under conditions which render the lubricant considerably more fluid than at room temperature.

Elevator Gears

On trucks of the hoist or lift type, involving gears for elevating purposes, the above discussion, relative to final drive gears and their lubrication, will be also applicable.

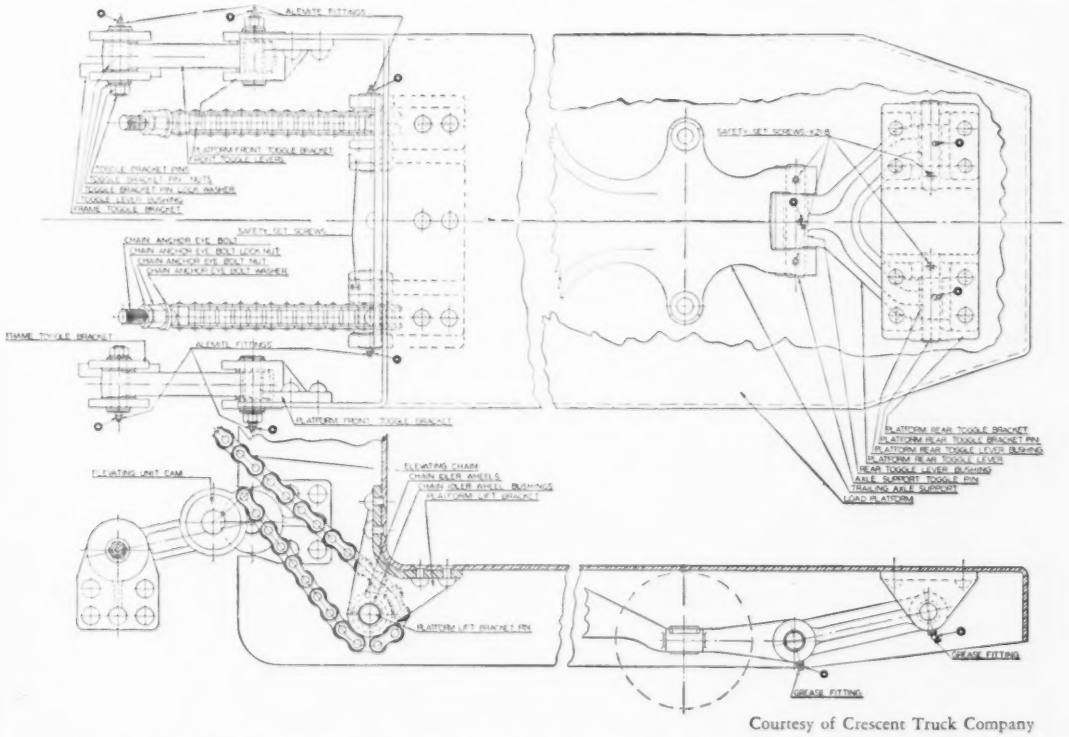
WHEEL BEARINGS, STEERING MECHANISMS, BRAKE CONNECTIONS AND UNIVERSALS

The other operating mechanisms on an electric industrial truck or tractor may be likened to the so-called chassis parts on the average automotive vehicle. In other words, wheel bearings, steering mechanisms, brake lever bearings, universals, etc., will be involved as well as other parts directly pertinent to manipulation of the electric truck such as controller shafts and drums, or switch mechanisms.

Grease or oil of varying characteristics will be required for their lubrication according to the type of service, the construction and the type of lubricating equipment provided. The type of lubricant is specified on most lubrication charts.

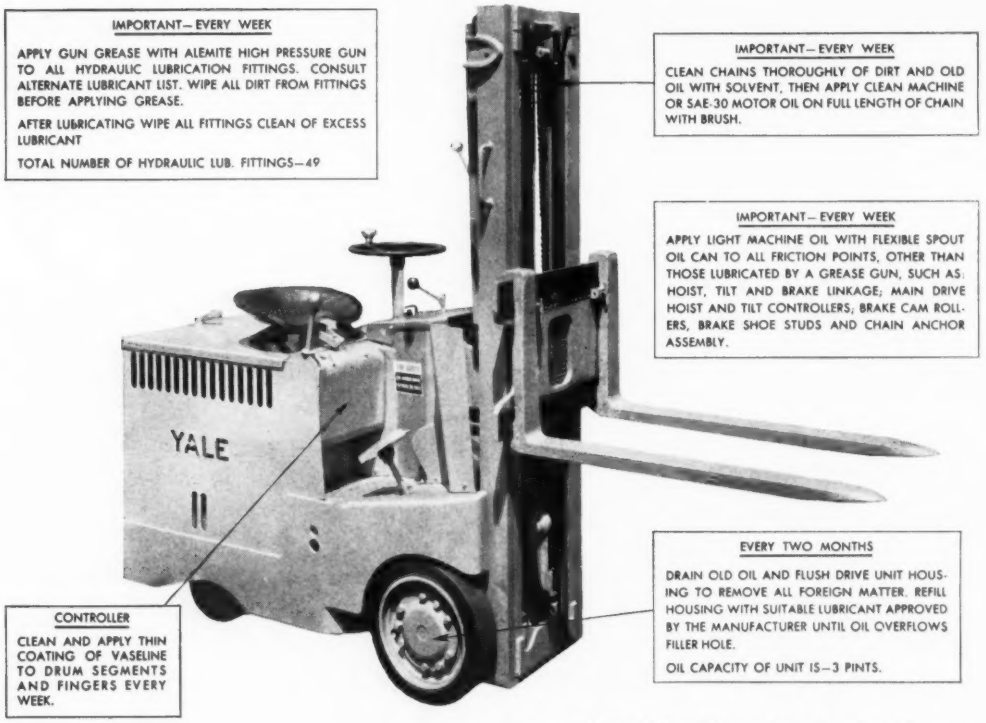
Oil is the usual recommendation for brake lever pins, controller shaft and spring pivot pins, switch rocker arm pins, certain steering lever pins, etc.

Pressure grease lubrication in turn is usually pre-



Courtesy of Crescent Truck Company

Fig. 7—Load platform and toggle bracket assembly for a Crescent Type NDRE low lift truck. Here again, as in Fig. 6, ● indicates pressure grease gun fittings. In this truck the driving unit consists of a double reduction silent chain to the worm and worm wheel drive. Both the chain and worm run in a bath of high quality oil within the SAE 140 range. The differential and chain case oil levels should be checked weekly and drained and re-filled monthly.


IMPORTANT—EVERY WEEK
APPLY GUN GREASE WITH ALEMITE HIGH PRESSURE GUN TO ALL HYDRAULIC LUBRICATION FITTINGS. CONSULT ALTERNATE LUBRICANT LIST. WIPE ALL DIRT FROM FITTINGS BEFORE APPLYING GREASE.
AFTER LUBRICATING WIPE ALL FITTINGS CLEAN OF EXCESS LUBRICANT
TOTAL NUMBER OF HYDRAULIC LUB. FITTINGS—49
IMPORTANT—EVERY WEEK
CLEAN CHAINS THOROUGHLY OF DIRT AND OLD OIL WITH SOLVENT, THEN APPLY CLEAN MACHINE OR SAE-30 MOTOR OIL ON FULL LENGTH OF CHAIN WITH BRUSH.
IMPORTANT—EVERY WEEK
APPLY LIGHT MACHINE OIL WITH FLEXIBLE SPOUT OIL CAN TO ALL FRICTION POINTS, OTHER THAN THOSE LUBRICATED BY A GREASE GUN, SUCH AS: HOIST, TILT AND BRAKE LINKAGE; MAIN DRIVE HOIST AND TILT CONTROLLERS; BRAKE CAM ROLLERS, BRAKE SHOE STUDS AND CHAIN ANCHOR ASSEMBLY.
YALE
EVERY TWO MONTHS
DRAIN OLD OIL AND FLUSH DRIVE UNIT HOUSING TO REMOVE ALL FOREIGN MATTER. REFILL HOUSING WITH SUITABLE LUBRICANT APPROVED BY THE MANUFACTURER UNTIL OIL OVERFLOWS FILLER HOLE.
OIL CAPACITY OF UNIT IS—3 PINTS.
CONTROLLER
CLEAN AND APPLY THIN COATING OF VASELINE TO DRUM SEGMENTS AND FINGERS EVERY WEEK.

Courtesy of The Yale and Towne Manufacturing Company.

Fig. 8—The Yale KM 30-2 center control telescopic tilting fork truck showing details relative to lubrication.

scribed for controller drum shafts, steering posts, drive and trailer wheel bearings, universal joints, switch rocker arms, steering knuckles and axle springs.

In many cases, however, grease or oil of the proper characteristics will function equally well, provided that proper lubricating equipment is installed for economical and positive application of the lubricants.

Wheel Bearings

Lubricating both drive and trailing wheel bearings with grease is practically universal on the modern electric truck. Either ball or roller bearings are used on all the leading types of trucks to carry these wheels. While virtually oil-tight in construction, the extent of pressure involved and the necessity for continued service under frequently very exacting conditions, with assurance of an adequate seal against entry of abrasive foreign matter, has led to the preference for grease.

A grease specifically designed for wheel bearings should be used. The frequency of application will of course depend upon the type of truck, and the design of these bearings. On some machines relubrication once every six months will suffice. On others, it will be necessary to remove the hub caps and pack the bearings about once a month.

The Steering Mechanism

Both oil and grease must be used for the steering gear. For example, knuckles, drag links, steering posts, and bell cranks are usually provided with means for grease lubrication. Steering posts and lever pins, etc., must in turn be oiled on many trucks. Where the lubricant must function for a considerable period of operation, where pressures may be high, or where leakage may occur, pressure-resistant chassis grease should be used.

Grease applied under sufficient pressure at weekly intervals as recommended by certain prominent truck builders by means of a pressure gun also will insure effective cleansing of the entire bearing or housing, old lubricant plus dirt, etc., being driven out as fresh lubricant is forced in.

Brake Connections

Brake connections including shoes, levers, pedals, platform shaft pin bearings, link pins, etc., should be oiled, according to most manufacturers' recommendations. These parts are much similar to the corresponding parts on the average motor car brake mechanisms, involving pin connections and plain bearing surfaces.

For these parts a medium bodied straight mineral oil within the SAE 20 range usually will be satisfactory. Such an oil in fact is adaptable to all those external parts on the electric truck as may require periodic lubrication by means of an oil can.

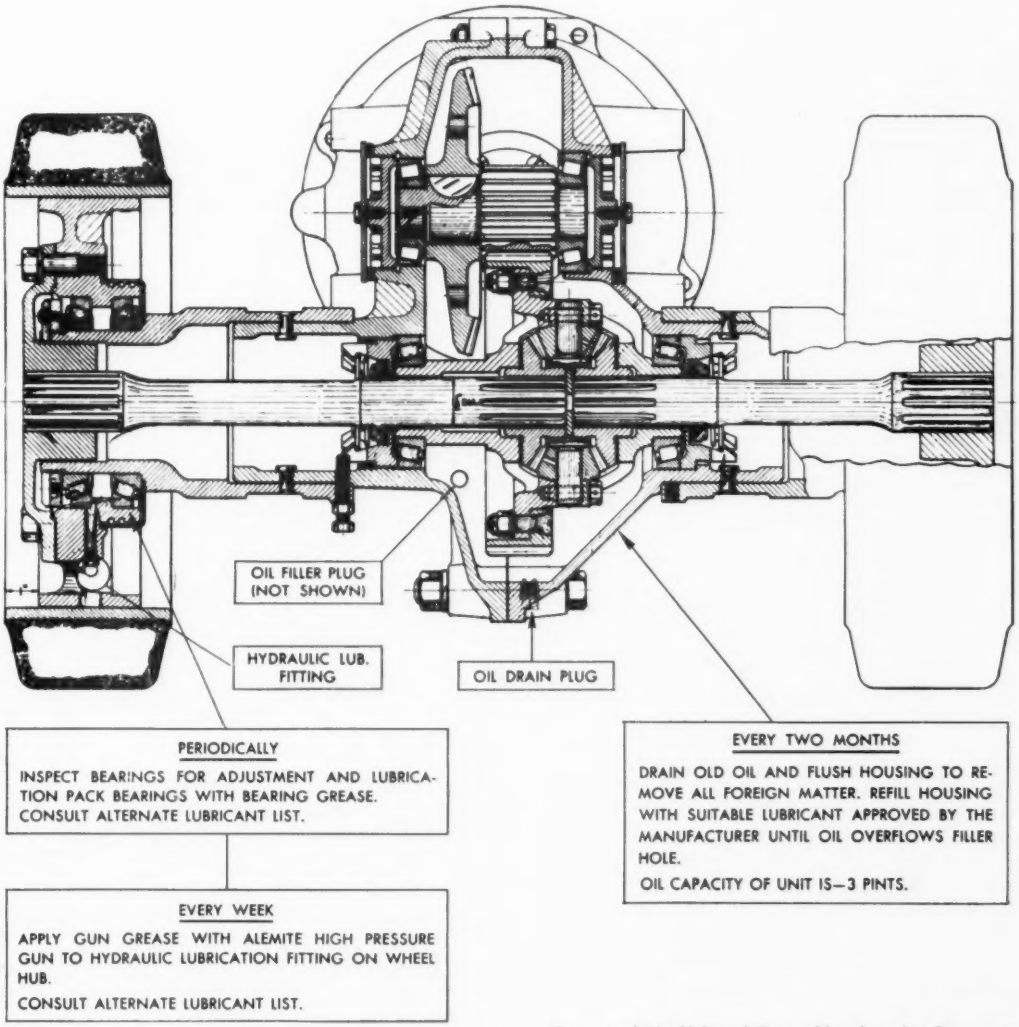
Brake cam shafts, on self-loading trucks, for example, will on the other hand be frequently fitted with pressure grease fittings or grease cups. With the former, re-greasing once a week will suffice. With the latter, the cups should be given one turn daily. In both cases a light or medium cup grease should be used.

Universals

Universal joints are involved on both sides of certain types of electric trucks. Frequently such joints will present a problem of lubrication due to the rotational speeds involved, especially when they are installed on the propeller shaft. The resultant centrifugal force will often tend to throw off the lubricant from the cross pin bearings, to cause loss or waste, or at least the possibility of insufficient lubrication.

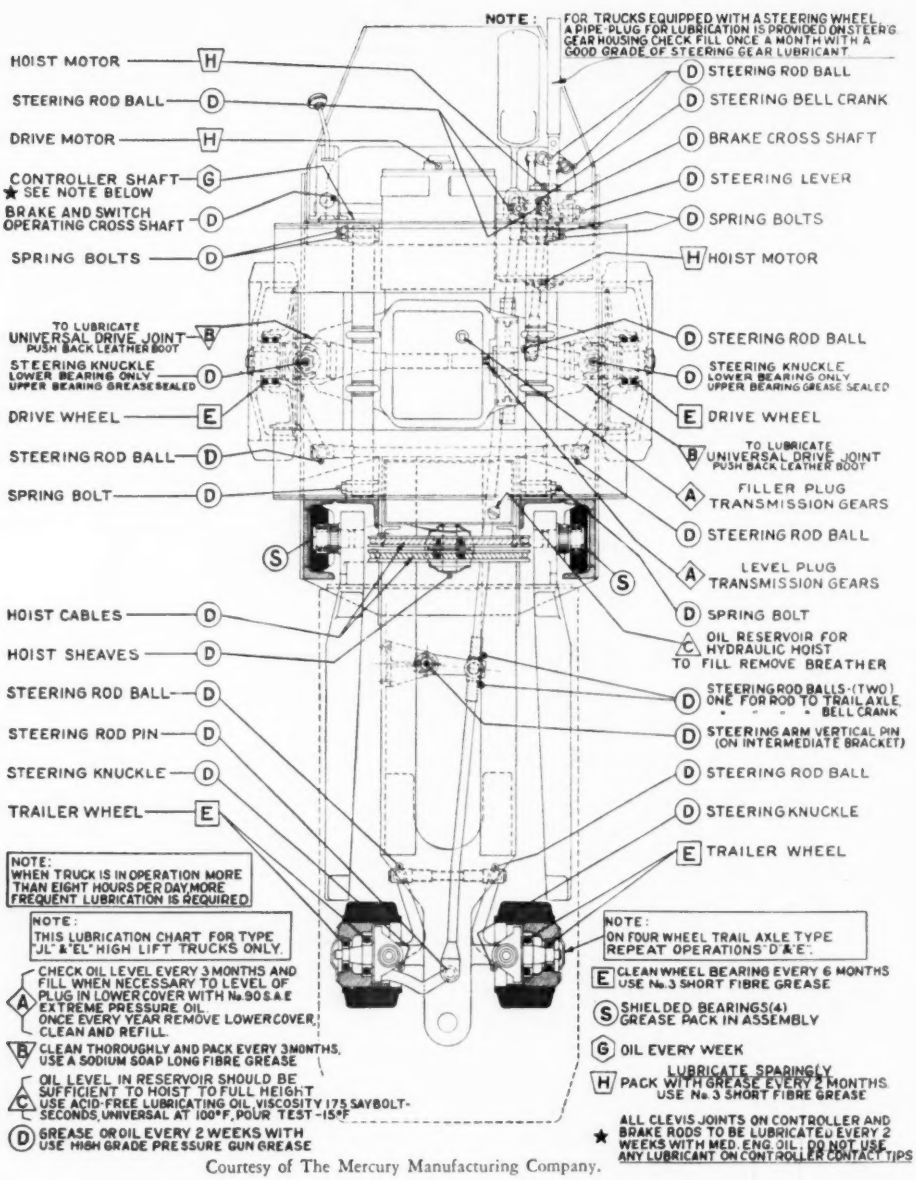
On four-wheel steer trucks with the motor direct connected to a drive worm, the universal joints are on the wheel driving shafts. Speeds here seldom exceed 100 R.P.M.

On starting either type of truck there may often be the possibility of development of abnormal pressure, the lubricant being forced out through the sealing cap or grease retainer if too light. For this reason the utmost care must be observed in selecting a grease of sufficient body and adhesive characteristics to resist such effects as far as possible.


OIL FILLER PLUG (NOT SHOWN)
HYDRAULIC LUB. FITTING
OIL DRAIN PLUG
PERIODICALLY
INSPECT BEARINGS FOR ADJUSTMENT AND LUBRICATION PACK BEARINGS WITH BEARING GREASE.
CONSULT ALTERNATE LUBRICANT LIST.
EVERY WEEK
APPLY GUN GREASE WITH ALEMITE HIGH PRESSURE GUN TO HYDRAULIC LUBRICATION FITTING ON WHEEL HUB.
CONSULT ALTERNATE LUBRICANT LIST.
EVERY TWO MONTHS
DRAIN OLD OIL AND FLUSH HOUSING TO REMOVE ALL FOREIGN MATTER. REFILL HOUSING WITH SUITABLE LUBRICANT APPROVED BY THE MANUFACTURER UNTIL OIL OVERFLOWS FILLER HOLE.
OIL CAPACITY OF UNIT IS—3 PINTS.

Courtesy of The Yale and Towne Manufacturing Company.

Fig. 9—Drive unit assembly for a typical Yale truck showing parts relation and instructions for lubrication.


NOTE: FOR TRUCKS EQUIPPED WITH A STEERING WHEEL A PIPE PLUG FOR LUBRICATION IS PROVIDED ON STEERG GEAR HOUSING CHECK FILL ONCE A MONTH WITH A GOOD GRADE OF STEERING GEAR LUBRICANT
HOIST MOTOR — H
STEERING ROD BALL — D
DRIVE MOTOR — H
CONTROLLER SHAFT — G
★ SEE NOTE BELOW
BRAKE AND SWITCH OPERATING CROSS SHAFT — D
SPRING BOLTS — D
TO LUBRICATE UNIVERSAL DRIVE JOINT — B
PUSH BACK LEATHER BOOT
STEERING KNUCKLE LOWER BEARING ONLY UPPER BEARING GREASE SEALED — D
DRIVE WHEEL — E
STEERING ROD BALL — D
SPRING BOLT — D
HOIST CABLES — D
HOIST SHEAVES — D
STEERING ROD BALL — D
STEERING ROD PIN — D
STEERING KNUCKLE — D
TRAILER WHEEL — E
NOTE: WHEN TRUCK IS IN OPERATION MORE THAN EIGHT HOURS PER DAY MORE FREQUENT LUBRICATION IS REQUIRED
NOTE: THIS LUBRICATION CHART FOR TYPE "JL" & "EL" HIGH LIFT TRUCKS ONLY.
A — CHECK OIL LEVEL EVERY 3 MONTHS AND FILL WHEN NECESSARY TO LEVEL OF PLUG IN LOWER COVER WITH No 90 S.A.E EXTREME PRESSURE OIL ONCE EVERY YEAR REMOVE LOWER COVER, CLEAN AND REFILL.
B — CLEAN THOROUGHLY AND PACK EVERY 3 MONTHS, USE A SODIUM SOAP LONG FIBRE GREASE
C — OIL LEVEL IN RESERVOIR SHOULD BE SUFFICIENT TO HOIST TO FULL HEIGHT USE ACID-FREE LUBRICATING OIL, VISCOSITY 175 SAYBOLT-SECONDS, UNIVERSAL AT 100°F, POUR TEST -15°F
D — GREASE OR OIL EVERY 2 WEEKS WITH USE HIGH GRADE PRESSURE GUN GREASE
D STEERING ROD BALL
D STEERING BELL CRANK
D BRAKE CROSS SHAFT
D STEERING LEVER
D SPRING BOLTS
H HOIST MOTOR
D STEERING ROD BALL
D STEERING KNUCKLE LOWER BEARING ONLY UPPER BEARING GREASE SEALED
E DRIVE WHEEL
B TO LUBRICATE UNIVERSAL DRIVE JOINT PUSH BACK LEATHER BOOT
A FILLER PLUG TRANSMISSION GEARS
D STEERING ROD BALL
A LEVEL PLUG TRANSMISSION GEARS
D SPRING BOLT
C OIL RESERVOIR FOR HYDRAULIC HOIST TO FILL REMOVE BREATHER
D STEERING ROD BALLS-(TWO) ONE FOR ROD TO TRAIL AXLE BELL CRANK
D STEERING ARM VERTICAL PIN (ON INTERMEDIATE BRACKET)
D STEERING ROD BALL
D STEERING KNUCKLE
E TRAILER WHEEL
NOTE: ON FOUR WHEEL TRAIL AXLE TYPE REPEAT OPERATIONS 'D' & 'E'.
E CLEAN WHEEL BEARING EVERY 6 MONTHS USE No. 3 SHORT FIBRE GREASE
S SHIELDED BEARINGS(4) GREASE PACK IN ASSEMBLY
G OIL EVERY WEEK
LUBRICATE SPARINGLY
H PACK WITH GREASE EVERY 2 MONTHS. USE No. 3 SHORT FIBRE GREASE
★ ALL CLEVIS JOINTS ON CONTROLLER AND BRAKE RODS TO BE LUBRICATED EVERY 2 WEEKS WITH MED. ENG. OIL; DO NOT USE ANY LUBRICANT ON CONTROLLER CONTACT TIPS

Courtesy of The Mercury Manufacturing Company.

Fig. 10—Lubrication chart for a Mercury high-lift platform truck.

CONCLUSION

The adaptability of the electric truck and tractor to short haul transportation has been the solution to many a production problem. Quite as important has been the adaptability of precision mechanisms to truck and tractor assembly and the availability of precision lubricants for these mechanisms. Effective lubrication is the key to continued operation. Accordingly bearings and gear assemblies can only be as dependable as their lubricants.

Industrial transportation equipment is a vital part of any production schedule. From building to yard, from heat-treating room to stockpile, etc, perhaps to buck a snowdrift now and then; later, to endure the sizzling heat next to an oven. Nor can the operator choose his operating conditions or always adapt his lubricants to meet these conditions.

This is why rugged heavy-duty lubricants are most adaptable. Products which can stand these widely varying conditions. Greases which will not break-down or separate. Gear lubricants which will protect gear teeth under shock loads. Oils which will flow below zero, yet protect at 200. That is the contribution of the petroleum industry to industrial transportation.

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INDUSTRIAL HAULING EQUIPMENT

Electric Trucks, Electric Tractors, Electric Hoists

ELECTRIC MOTOR BEARINGS (Ball or Roller Type)

Grease Lubricated (According to Type)	Texaco Regal Starfak Grease or Texaco Marfak
Oil Lubricated — Normal Conditions	Texaco Cetus Oil or Texaco Alcaid Oil
When Temperatures are High or Speeds are Low	Texaco Algol Oil or Texaco Ursa Oil

GEARS

Differential and Elevating Gears	Texaco Thubans or Texaco Hypoid Thubans

STEERING MECHANISMS

Drag Links, Knuckles, Bell Cranks Upper and Lower Steering Posts Handles	Texaco Starfak Grease M Texaco Cup Grease No. 1 or No. 2 or Texaco Marfak
Bell Crank Pins, Lever Pins Steering Post Arm Pins Fore and Aft Knuckle Lever Pins	Texaco Algol Oil

BRAKE CONNECTIONS

Brake Shoes, Levers, Pedals, etc. Cam Shaft (on Certain Trucks)	Texaco Algol Oil Texaco Starfak Grease M or Texaco Cup Greases

WHEEL BEARINGS

Ball or Roller Type	Texaco Marfak or Texaco Starfak Grease H

UNIVERSALS

Universal Joints—Grease Lubricated	Texaco Marfak

CONTROLLING MECHANISMS

Shaft Gears, Drums and Handles	Texaco Starfak Grease L or Texaco Cup Grease No. 1
Shaft Lever Pin Spring Pivot Pin	Texaco Algol Oil

SWITCH ELEMENTS

Rocker Arms	Texaco Starfak Grease L or Texaco Cup Grease No. 1
Platform Shaft Bearings Rocker Arm Pins (Front and Rear) Platform Lever Pins Platform Shafts	Texaco Algol Oil

SPRING ELEMENTS

Grease Lubricated	Texaco Cup Greases
Waste Pad or Oil Lubricated	Texaco Algol Oil

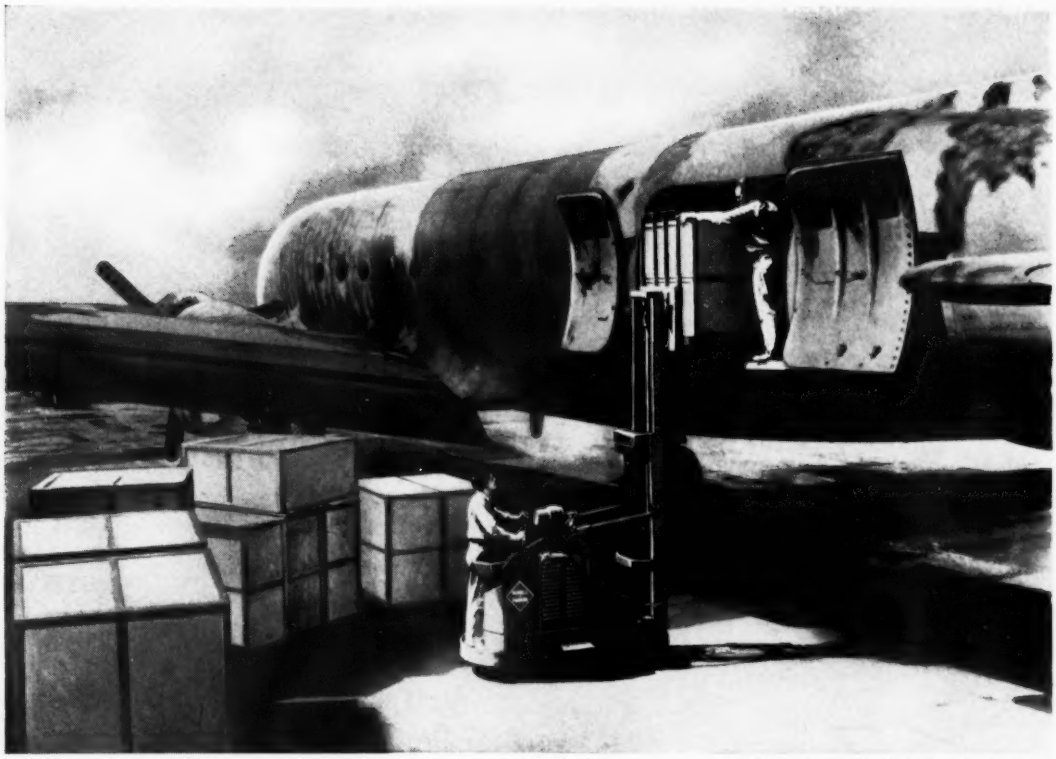

Photo Courtesy Elwell-Parker Electric Co.

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